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25 March 1970

Materiel Test Procedure 6-2-504\*  
Electronic Proving Ground

U. S. ARMY TEST AND EVALUATION COMMAND  
COMMON ENGINEERING TEST PROCEDURE

MAINTENANCE/MAINTAINABILITY

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1. OBJECTIVE

The objective of this materiel test procedure is to present a general methodology for reviewing a test item's characteristics so as to verify attainment of its quantitative and qualitative maintenance/maintainability requirements.

2. BACKGROUND

The national defense posture is heavily dependent upon materiel readiness. Maintainability is a prime contributor to this readiness, for it is the design element that can eliminate the need for excessive support requirements.

Quantitative demonstration of the extent to which maintainability has been successfully incorporated into a systems design is, ideally, the objective of a valid maintainability test of that system. Actually, however, the most carefully planned and skillfully executed test of this sort will produce only measurements of the symptoms of maintainability. Analysis of the causes of unsatisfactory results, if such are found, and treatment to correct them must be carried out by a broad review program which encompasses all available maintenance/maintainability data.

Maintenance/maintainability data collection is important to reveal significant maintenance trends early in the testing cycle.

3. REQUIRED EQUIPMENT

- a. Bench test facilities and inspection rack.
- b. Maintenance Test Package (appropriate publications, tools and test equipment).
- c. Photographic equipment.
- d. Laboratory apparatus as required to demonstrate the test item's inherent safety, physical, human factors and accessibility characteristics.

4. REFERENCES

- A. AR 705-26, Maintainability Program for Materiel and Equipment.
- B. AR 750-1, Maintenance Concepts.
- C. AR 750-2, National Maintenance Points.
- D. AR 750-5, Organization, Policies and Responsibilities for Maintenance Operations.
- E. AR 750-6, Maintenance Support Planning.
- F. AMCR 700-60, Maintainability Program for AMC Materiel.
- G. USATECOM Regulation 385-6, Verification of Safety During Testing.
- H. USATECOM Regulation 70-23, Equipment Performance Report.
- I. USATECOM Regulation 750-15, Maintenance of Supplies and Equipment.

\* This MTP supersedes MTP 6-2-504, March 1967.

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Aberdeen Proving Ground, Md. 21005

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- J. MIL-STD-280, Definitions of Item Levels, Item Exchangeability, Models and Related Items.
- K. MIL-STD-470, Maintainability Program Requirements (For Systems and Equipments).
- L. MIL-STD-471, Maintainability Demonstration.
- M. MIL-STD-721, Definition of Effectiveness Terms for Reliability, Maintainability, Human Factors and Safety.
- N. MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
- O. MIL-HDBK-472, Maintainability Prediction.
- P. AFSCM 80-1, Handbook of Instructions for Aircraft Designers, (Part I, Maintainability).
- R. AMC Pamphlet 706-134, Maintainability Guide for Design.
- S. DA Pamphlet 705-1, Maintainability Engineering.
- T. TM 38-750, Army Equipment Record Procedures.
- U. MTP 6-2-502, Human Factors Engineering.
- U. MTP 6-2-507, Safety.

## 5. SCOPE

The procedures herein apply to all engineering tests and such other tests designated by USATECOM as requiring a maintenance/maintainability evaluation of the test item.

### 5.1 SUMMARY

The procedures herein provide for the accumulation of maintenance/maintainability data in accordance with prescribed regulations.

### 5.2 LIMITATIONS

It is not feasible to staff test agencies with all the MOS required to perform the direct and general support maintenance portions of a test on complex systems. The procedures herein provide for engineering personnel to evaluate maintainability and maintenance functions and may not reflect the effects of employing appropriate MOS personnel.

## 6. PROCEDURES

### 6.1 PREPARATION FOR TEST

General test preparations shall include but not necessarily be limited to the following:

- a. Orientation of test personnel on the test requirements as stipulated in the applicable QMR, SDR, TC or test directive and on information derived from test item instructional material and reports of comparable tests.
- b. Review of test item maintainability plan, maintainability prediction and background material delineated in paragraph 4.
- c. Prepare adequate safety precautions in accordance with MTP 6-2-507, to provide safety for personnel and equipment.

- d. Ensure that a safety release has been received in accordance with USATECOM Regulation 385-6.
- e. Provision of record forms and equivalent material suitable for recording the required data. (Maintenance and Reliability Analysis Chart, Parts Analysis Chart and Maintenance Package Literature Chart are mandatory.)
- f. Coordinated action to ensure that maintenance/maintainability testing is integrated as much as possible with related data collection requirements such as reliability.
- g. Coordinated action to ensure that all necessary data will be accumulated during routine maintenance operations performed in support of the engineering test under laboratory or field conditions.

## 6.2 TEST CONDUCT

NOTE: The evaluation of test item maintenance/maintainability is an integral part of the entire test program and will be conducted concurrently with other operations as applicable. Separate maintenance operations, however, will be performed when necessary to meet the requirements imposed by regulations and the test directive. Each of the following major areas of interest will be covered and may be further broken down or modified commensurate with the complexity of the maintainability subtest based on the depth of coverage, degree of detail and amount of subsidiary material.

### 6.2.1 Maintenance Test Package

- a. Following receipt of the test item, check the presence and contents of the maintenance test package. The maintenance test package definition contained in the glossary shall be used as a guide in ascertaining package completeness. Missing or inappropriate technical manuals, instructions, parts lists, etc., shall be reported on EPR's in accordance with USATECOM Regulation 70-23.

### 6.2.2 Maintainability

- a. During the entire test period, perform and record all scheduled and unscheduled maintenance operations in accordance with prescribed procedures in draft publications for the test item.
  - 1) Organizational Maintenance. All authorized organizational maintenance operations listed on the Maintenance Allocation Chart (MAC) shall be performed on the test item and associated equipment. Normally data will be accumulated during routine maintenance operations performed in support of the engineering test.
  - 2) Direct and General Support Maintenance. The same general procedures shall be followed as with organizational maintenance evaluations except that, generally, only those functions need be performed that are necessary to support the item during test. When no requirement for a given maintenance

operation has arisen during the engineering test, each maintenance allocation chart function shall be performed or reviewed to the extent necessary to evaluate maintainability of the item.

b. As a part of the above procedure, monitor the test and maintenance functions and report difficulties as well as favorable aspects with respect to the guidelines promulgated in Appendix F and the following specific subjects:

- 1) Lubrication, replenishing tanks and reservoirs and recharging gas bottles.
- 2) Safety aspects of the maintenance operations. For example, make checks to determine what necessary drains, pressure relief valves, electrical interlocks and cut-off switches are present and operative. Evaluate warning plates and instruction plates for adequacy of content and conspicuous location. Inspect equipment to ensure that suitable guards and covers are provided for dangerously exposed moving parts, high voltage circuits, and parts operating at hazardously high or low temperatures.
- 3) Maintainability under extreme environments considering the protection and conditions expected to exist for the maintenance categories in question (where possible).
- 4) Time required for individual maintenance operations to determine whether or not the resulting down-time is considered excessive based on experience with like-type items. Compute maintenance ratio (see Glossary). Observe whether time for a given maintenance operation is increased or the intervals between routine maintenance operations shortened as a result of extended usage.
- 5) Compare parts or modules provided with the test item with anticipated maintenance requirements to evaluate spare parts requirements.
- 6) Examine and evaluate storage compartments to assure that adequate protection is provided against weather, grease, oil, dirt, and physical damage.
- 7) Human factors implications. Examples include direction and extent of lifting required during disassembly or assembly; adequacy of hoisting, lifting, and towing facilities available; freedom of the worker to reach and work adequately (as influenced by the configuration or placement of the work, or by his clothing or size).
- 8) Factors such as ease of access to components, test points, modular construction, built-in "go no go" simple fault isolation indicators which establish that ease of maintenance has been included in the design. Make note also of factors such as reliability of components, ability of protective devices to prevent damage during maintenance, and other factors which indicate that the design of the equipment has been directed toward minimizing maintenance.

c. Maintain a record of scheduled and unscheduled maintenance and operating hours throughout the test including spare parts usage, on Maintenance and Reliability Analysis Charts and Parts Analysis Charts. These forms are for the test report. Appendices A and B provide instructions and sample forms. Additionally, appropriate DA forms contained in TM 38-750 may be used as aids in recording maintenance and parts data compiled during the engineering test.

#### 6.2.3 Tools and Test Equipment

a. Utilize all common and special tools and equipment supplied with the test item in accordance with prescribed maintenance procedures and determine whether these items are suitable for the intended purpose and maintenance level.

b. Record these data on the Special Tool Analysis Chart in accordance with the specified instructions. Appendix C provides instructions and sample forms.

#### 6.2.4 Technical Manuscripts and Manuals

a. Analyze maintenance instructions contained in technical manuscripts and manuals, maintenance charts and lubrication orders throughout the test for all applicable operations including the requirements delineated in the Maintenance Package Literature Chart in Appendix D.

b. Analyze and record the need for and adequacy of special training requirements. Specify maintenance levels requiring special training.

c. Analyze maintenance instructions for simplicity and clarity. Examine block and circuit diagrams and drawings for completeness and accuracy. Check troubleshooting instrumentation and aids, as applicable, during the test. Check preventive maintenance procedures for completeness. Analyze adequacy of safety instruction for personnel and equipment, including environmental protection during operation and maintenance.

d. Report errors or omissions in nomenclature and stock numbers on repair parts lists.

e. Check equipment serviceability criteria at appropriate periods during the tests.

f. Observe closely maintenance operations actually performed in an effort to determine whether instructions are clear and sequence of operations is adequate for the level of training specified for the maintenance personnel.

g. Report changes or comments on DA form 2028 as exemplified in Appendix E.

### 6.3 TEST DATA

#### 6.3.1 Maintenance Test Package

a. Record maintenance test package contents.

b. Indicate test package completeness.

c. Complete EPR's as necessary in accordance with USATECOM Regulation

70-23.

6.3.2 Maintainability

- a. Report all difficulties as well as favorable aspects of equipment maintainability as evidenced throughout the engineering test.
- b. Report deficiencies or sufficiencies in equipment design and maintenance concepts with respect to the specific subjects promulgated in paragraph 6.2.2 and the guidelines delineated in Appendix F.
- c. Complete all forms specified in paragraph 6.2.2.c in accordance with instruction sheets provided in Appendices A and B.
- d. Complete appropriate DA forms contained in TM 38-750, as applicable.

6.3.3 Tools and Test Equipment

Complete the Special Tool Analysis Chart in accordance with the instructions provided in Appendix C.

6.3.4 Technical Manuscripts and Manuals

Report all errors, omissions, comments and recommended changes in maintenance test package literature on the forms specified in Appendix D. Paragraph by paragraph changes should be reported on DA Form 2028 as indicated in Appendix E.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

The maintenance/ maintainability subtest of the test report will contain a summary of a narrative evaluation of the data presented on the forms. Classify and identify deficiencies and shortcomings.

- a. Compute the following, when required:

- 1) Total hours of operation (T)
- 2) Total active man-hours required to repair failures (TM)
- 3) Number of failures (R)
- 4) Mean Time to Repair (MTTR)

$$MTTR = \frac{TM}{R}$$

- 5) Demonstrated Mean Time Between Failure (MTBF)

$$MTBF = \frac{T}{R}$$

- 6) The lower confidence limit of the true MTBF ( $M_1$ )

$$M_1 = \frac{2T}{\chi^2_{2(R+1)} \cdot 10}$$



- 7) The upper confidence limit of the true MTBF ( $M_2$ )

$$M_2 = \frac{2T}{\chi^2_{2R} \cdot 90}$$

NOTE: MTP 3-1-002, Confidence Intervals and Sample Size should be consulted for statistical tables and derivation of the above formulae.

6.4.2 Forms

Present a set of the completed forms in the test report as an appendix entitled "Maintenance Evaluation". Sample completed forms are provided in Appendices to this MTP.

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GLOSSARY

- ACTIVE MAINTENANCE TIME - Active Maintenance Time is expressed in manhours accumulated during maintenance operations. This time includes preparation time, fault-location time, part-replacement time, adjustment and recalibration time, and final test time. Active Maintenance Time will also include time to conduct scheduled maintenance operations and schedules inspections whether they be on a miles, hours, rounds, basis or on a calendar basis.
- ADJUSTMENT AND RECALIBRATION TIME - Adjustment and Recalibration Time is that element of active maintenance time required to make the adjustment and/or calibrations necessary to place the material in a satisfactory performing condition.
- FAILURE - Failure is the cessation of ability of an item to meet the minimum specified performance.
- FAULT LOCATION TIME - Fault Location Time is that element of active maintenance time for testing and analysis of materiel to isolate trouble.
- FINAL TEST TIME - Final Test Time is that element of active maintenance time required after completion of repairs, adjustments, and calibration to verify by measurement of performance that the materiel is in a condition to satisfactorily perform its function.
- MAINTENANCE RATIO - Maintenance Ratio is the number of active maintenance manhours (TM) required to support each hour of operation (TO); i.e.,

$$M = \frac{TM}{TO} .$$

This figure reflects the frequency of failures of the system; the amount of time required to locate, repair, or replace the faulty component or part and to some extent the overall maintainability of the system. Under a given set of operating conditions, this method of measurement provides a figure of merit for use in estimating maintenance manpower requirements.

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**MAINTENANCE TEST PACKAGE**

- An assemblage of support elements provided prior to and utilized during engineering and service tests to validate the organizational, direct and general support maintenance capability. The maintenance test package includes all required draft equipment publications (operator through general support maintenance equipment manuals, AR 310-3), repair parts, accessories, special and common tools, test, support and ground handling equipment, multipurpose test equipment, calibration and maintenance/calibration shop facilities, and personnel skill requirements.

**MEAN TIME BETWEEN FAILURES**

- MTBF for a particular equipment in a given interval is the mean value of the operating time between all failures occurring in that equipment during that interval.

**OPERATING TIME**

- Operating Time is the time an item or system is in an operational condition and is being operated, handled, or moved in an actual or simulated field environment. For aircraft, operating time will be computed as indicated in paragraph 73, AR 95-4.

**PART-REPLACEMENT TIME**

- Part-Replacement Time is that element of active maintenance time required to set up materiel in preparation for fault-location.

**SCHEDULED MAINTENANCE**

- Scheduled Maintenance is the care and servicing at specified intervals for the purpose of maintaining equipment in a satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures, either before they occur, or before they develop into major defects. Schedules Maintenance Time will include that time consumed as a result of repairs found to be required during scheduled maintenance operations. For the purposes of this regulation, daily services performed by the equipment operator or crew are not considered as scheduled maintenance function.

**UNSCHEDULED MAINTENANCE**

- Unscheduled Maintenance is adjustments, replacements, and repair operations performed on equipment other than those conducted as a result of scheduled maintenance services.

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Unscheduled maintenance time will also include that time required to conduct repairs found to be needed during daily services.

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APPENDIX A  
MAINTENANCE AND RELIABILITY ANALYSIS CHART  
INSTRUCTION SHEET

| <u>COLUMN</u> | <u>DESCRIPTION</u>  |
|---------------|---|
| 1             | Entry number of each item.  |
| 2             | Group number as indicated in the Maintenance Allocation Chart.  |
| 3             | Component and related operations as indicated in the Maintenance Allocation Chart. Operations indicated as in Depot Category are not shown.   |
| 4             | Maintenance Level, Prescribed. Category prescribed by the Maintenance Allocation Chart is indicated by utilizing the letters O/C, O, DS, or GS. O/C - Operator or crew; O - Organizational; DS - Direct Support; GS - General Support.  |
| 5             | Maintenance Level, Recommended. Letters O/C, O, DS, or GS indicate the category recommended by the test agency.   |
| 6             | TM Instructions, Adequate: An X in this column indicates the TM instructions are considered adequate.   |
| 7             | TM Instructions, Inadequate. The test agency reference number used on DA Forms 1598/2028 is indicated in this column, if the instructions are considered inadequate.  |
| 8             | Active Maintenance Time. Man-hours used to the closest tenth. If the operation was not actually performed but was reviewed, the estimated active maintenance time is indicated by using the prefix E. Average active maintenance time is used if the operation was performed more than once.  |
| 9             | Life. Number of hours, miles, or rounds accumulated before or since this operation was performed. An entry is made each time this operation is performed, followed by the appropriate life unit; i.e., M, H, or R. An "S" will be placed in this column if the operation was performed on a sampling basis and not because of an actual failure.  |
| 10            | Reason performed. The symbol "Unsched" will be shown in this column if the operation was performed as a result of unscheduled maintenance. If the operation was performed as a result of scheduled maintenance, it is indicated by the symbol "Sched" in this column. If the operation was performed only to verify procedures and tools, not as a result of breakdown, it is indicated by the symbol "Sim" in this column. |

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COLUMN

DESCRIPTION

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Remarks. If the operation is related to any other subtest covered in the body of the test report, the paragraph number is inserted for cross reference. If the operation was not performed as a result of using the sampling technique authorized by AR 750-6, one of the following remarks is entered as appropriate.

- a. Reviewed - not performed.
- b. Neither reviewed nor performed due to (No TM's) or (insufficient service test time).
- c. Other, as appropriate.

If an EPR is related to a maintenance operation, the EPR number will be inserted.



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MAINTENANCE AND RELIABILITY ANALYSIS CHART

| ENTRY NO | GROUP NO | COMPONENT AND RELATED OPERATIONS | O/C-Oper/Crew |           |            | INSTRUCTIONS |                    | ACTIVE MAINT TIME | LIFE M-Miles H-Hours R-Rounds | REASON PERFORMED | REMARKS  |
|----------|----------|----------------------------------|---------------|-----------|------------|--------------|--------------------|-------------------|-------------------------------|------------------|--|
|          |          |                                  | O-Orgn        | DS-Direct | CS-General | Ade-quate    | Inade-quate        |                   |                               |                  |  |
| 1        | 2        | 3                                | 4             | 5         | 6          | 7            | 8                  | 9                 | 10                            | 11               |  |
| 1        |          | AN/URC-68 Radio Set S/N 00035A   |               |           |            |              |                    | 8.OH              | Unscheduled                   |                  |  |
|          |          | a. Test power-on inspection      | DS            | DS        |            |              | DA1598 20 Dec 1968 | 2.0               |                               |                  | Bench test to verify failure and locate fault. Squelch was uncontrollable. Test personnel were unable to determine cause of failure. |
|          |          | b. Repair                        | None          | None      | N/A        | N/A          |                    | 0.5               |                               |                  | Cardboard inserted (temporarily) into cover to improve electrical connections.   |
| 2        |          | c. Test                          | DS            | DS        | X          |              |                    | 0.1               |                               |                  | Final test to verify repair.   |
|          |          | AN/URC-68 Radio Set S/N 00053A   |               |           |            |              |                    | 40.OH             | Unscheduled                   |                  | Reported by operator during normal use.  |

SAMPLE DATA

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MAINTENANCE AND RELIABILITY ANALYSIS CHART

| ENTRY NO | ENTRY NO | COMPONENT AND RELATED OPERATIONS                           | O/C-Oper/Crew |           |            | TM INSTRUCTIONS |             |                   | LIFE M-Miles H-Hours R-Rounds | REASON PERFORMED   | REMARKS |
|----------|----------|--|---------------|-----------|------------|-----------------|-------------|-------------------|-------------------------------|--|---------|
|          |          |  | O-Orgzn       | DS-Direct | GS-General | Ade-quate       | Inade-quate | ACTIVE MAINT TIME |                               |  |         |
|          |          |  |               |           |            |                 |             |                   |                               |  |         |
| 1        | 2        | 3  | 4             | 5         | 6          | 7               | 8           | 9                 | 10                            | 11   |         |
| 3        |          | AN/URC-68<br>Radio Set<br>S/N 00032A<br>Monthly inspection |               |           |            |                 |             | 259.0H            | Scheduled                     | Completed in accordance with TM 11-5820-767-12.<br><br>Bench test using TS-2688/URC-68 completed in accordance with TM 11-5820-767-12. |         |
|          |          | a. Visual  | 0             | 0         | X          |                 | 0.2         |                   |                               |  |         |
|          |          | b. Tests: power-on inspection                              | 0             | 0         | X          |                 | 0.3         |                   |                               |  |         |
| 4        |          | AN/URC-68<br>Radio Set<br>S/N00033A<br>Monthly inspection  |               |           |            |                 |             | 259.5H            | Scheduled                     | Completed in accordance with TM 11-5820-767-12<br><br>Bench test using TS-2688/URC-  |         |
|          |          | a. Visual  | 0             | 0         | X          |                 | 0.2         |                   |                               |  |         |
|          |          | b. Test power  | 0             | 0         | X          |                 | 0.3         |                   |                               |  |         |

SAMPLE DATA

APPENDIX B  
PARTS ANALYSIS CHART  
INSTRUCTION SHEET

GENERAL: Parts will be assembled on this chart by functional groups and in numerical order within groups.

| <u>COLUMN</u> | <u>DESCRIPTION</u>   |
|---------------|--|
| 1             | Record one of the following: Federal Stock Number, Technical Service Part Number, Manufacturer's Part Number, or Drawing Number in this order of preference.   |
| 2             | Noun Nomenclature. Self-explanatory.   |
| 3             | Maintenance Level, Prescribed. Maintenance level as prescribed by the parts listed under review: O/C - Operator/Crew; O - Organizational; DS - Direct Support; GS - General Support.   |
| 4             | Maintenance Level, Recommended. O/C, O, DS, or GS indicate maintenance level recommended by the test agency.   |
| 5             | Life. The number of hours, miles, or rounds accumulated before or since this part was replaced. An entry in this column is made for each part used followed by the appropriate life unit; i.e., M, H, or R.  |
| 6             | Reason Used. The symbol "Unsched" will be shown in this column if the part was used as a result of unscheduled maintenance. If the part used was the result of scheduled maintenance, the symbol "Sched" will be used. If the part was consumed to verify procedures or tools, note as a result of breakdown, the symbol "Sim" will be used. |
| 7             | Group Number, Cross Reference. Parts usage by maintenance operation is indicated by cross referencing to the group number from Column 1 of the Maintenance and Reliability Analysis Chart.   |
| 8             | Remarks. If the part usage is related to any other subtest covered in the body of the test report, the paragraph number for cross reference is indicated. If an EPR is related to the part used, the EPR number will be inserted in this column.   |

PARTS ANALYSIS CHART

| FEDERAL STOCK NUMBER  | NOUN NOMENCLATURE      | MAINTENANCE LEVEL |              | LIFE M-Miles H-Hours R-Rounds | REASON USED | GP NO CROSS REFERENCE | REMARKS   |
|---|------------------------|-------------------|--------------|-------------------------------|-------------|-----------------------|---|
|   |                        | Pre-scribed       | Recom-mended |                               |             |                       |   |
| 1   | 2                      | 3                 | 4            | 5                             | 6           | 7                     | 8   |
| S820-055-7052   | Antenna Assembly       |                   | DS           | 0.0H                          | Unsched     |                       | Replaced on 3 of 4 radios under test. EPR's KZ-1 submitted. |
| S820-066-6920   | Modulator Module       | DS                | DS           | 0.0H                          | Unsched     |                       | EPR KZ-3 submitted.   |
| Unknown   | UHF Transmitter Module | DS                | DS           | 0.0H                          | Unsched     |                       | EPR KZ-5 submitted.   |
| Unknown   | CR-1 Diode             | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| Unknown   | CR-2 Diode             | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| Unknown   | CR-3 Diode             | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| Unknown   | CR-4 Diode             | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| Unknown   | L-1 Coil               | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| Unknown   | L-6 Coil               | None              | *            | 153.0H                        | Unsched     |                       | EPR KZ-7 submitted.   |
| *These parts were installed by the manufacturer. Maintenance of this type is beyond the normal scope of maintenance for this radio because the modules would be salvaged if repairs of this extent were required. |                        |                   |              |                               |             |                       |   |

SAMPLE DATA

APPENDIX C  
SPECIAL TOOL AND TEST EQUIPMENT CHART  
INSTRUCTION SHEET

| <u>COLUMN</u> | <u>DESCRIPTION</u>   |
|---------------|--|
| 1             | Nomenclature or Description. Enter the nomenclature as shown in the manual.  |
| 2             | Federal Stock Number, Technical Service Part Number, Manufacturer's Drawing Number.  |
| 3             | Maintenance Level, Prescribed. Maintenance level authorized the tool as prescribed by the manual.  |
| 4             | Maintenance Level, Recommended. Maintenance level recommended and tool authorized by the test agency.                                      |
| 5             | Date Received. The date the tool or test equipment was received. Enter "not rec" when applicable.  |
| 6,7           | "X" in appropriate column shows results of evaluation. No comment is made on tools marked "None" in column 4.                              |
| 8             | Required (RQR). A "yes" or "no" in this column indicates if tool or test equipment is required at maintenance level indicated in column 4. |
| 9             | Technical publication number, for the test item, in which tool or test equipment is listed.  |
| 10            | Remarks: If an EPR was related to the tool, the EPR number is shown in this column.  |

SPECIAL TOOL ANALYSIS CHART

| SPECIAL TOOL  | FUNCTION   | MAINTENANCE LEVEL |             |              | EVALUATION |             | REMARKS   |
|---|--|-------------------|-------------|--------------|------------|-------------|---|
|   |  | 0 - Organization  | DS - Direct | GS - General | Ade-quate  | Inade-quate |   |
| I   | 2  | 3                 | 4           | 5            | 6          | 7           |   |
| Module Removal Tool   | Remove modules from frame assembly control   |                   | DS          |              |            |             | Not available. Modules difficult to remove. (See paragraph 2.11.)   |
| Pin Straightener  | To insure that the pins on the modules are straight before insertion into sockets on frame assembly control. |                   | DS          |              |            |             | Not available. Pins of the modules subject to bend easily making modules difficult to install and possibly causing damage to pin sockets on frame assembly control. (See paragraph 2.11.) |
| NOTE: The above tools are recommended for inclusion in the maintenance package. |  |                   |             |              |            |             |   |
| TS-2688/JRC-68 Radio Test Set   | Check output power of transmitter modules and remaining battery life.  |                   |             |              | X          |             | (See paragraph 2.11.)   |

SAMPLE DATA

APPENDIX D  
MAINTENANCE PACKAGE LITERATURE CHART  
INSTRUCTION SHEET

| <u>COLUMN</u> | <u>DESCRIPTION</u>  |
|---------------|---|
| 1             | Give Army or manufacturer's publication or draft manual number.   |
| 2             | Number of copies received. Insert "0" if none were supplied. Use Para III i, Chapter 9, of AR 310-3 as a guide to determine those manuscripts and publications that should accompany the test item. Manuscripts and publications contained in the maintenance package should cover operations and functions through general support maintenance and should specify the categories involved. |
| 3             | Complete title.   |
| 4             | Fill in date manuscript (MSS) or publication was received.  |
| 5             | Fill in date test item or materiel was received.  |
| 6,7           | Insert "X" in appropriate block. Minor errors on 1598 forms are not in themselves sufficient reason to term a manuscript inadequate. Evaluation <u>may</u> be omitted if fewer than 25% of the specified maintenance operations were performed.   |
| 8             | Insert date 1598 form was forwarded.  |
| 9             | In addition to appropriate remarks, explain if manuscript was <u>not</u> evaluated.   |

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MAINTENANCE PACKAGE LITERATURE CHART

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| TM 11-5820-767-12 | 14   | "Preliminary Operator and Organizational Maintenance Manual Radio Set AN/URC-68" dated 1968 | 23 Oct 68     | 23 Oct 68 |      |            |                      |         | Not evaluated. This preliminary manual superseded by later manual. |  |
| TM 11-5829-767-12 | 5    | "Operator and Organizational Maintenance Manual, Radio Set AN/URC-68," dated 8 Aug 68       | 1 Nov 68      | 23 Oct 68 |      | X          | DA 2028<br>20 Dec 68 |         | Superseded above item.   |  |
| TM 11-5820-767-35 | 1    | "Preliminary DS, CS, and Depot Maintenance Manual, Radio Set AN/URC-68" dated 1968          | 8 Nov 68      | 23 Oct 68 |      | X          | DA 1598<br>20 Dec 68 |         |  |  |

SAMPLE DATA



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APPENDIX F

GUIDELINES FOR AN ENGINEERING ANALYSIS OF  
MAINTENANCE/MAINTAINABILITY

In general, the following maintainability guidelines should be reflected in equipment design and maintenance concepts:

- a. Reduce the complexity of maintenance by:
  - 1) Providing adequate accessibility, work space and work clearance.
  - 2) Providing for interchangeability of like components, materials and parts within the system/equipment.
  - 3) Utilizing Mil-Standard parts and items within the government inventories.
  - 4) Limiting the number and variety of tools, accessories and support equipment.
  - 5) Insuring compatibility among system equipment and facilities.
- b. Reduce the need for and frequency of design-dictated maintenance activities by using:
  - 1) Fail-safe features.
  - 2) Components which require little or no preventive maintenance.
  - 3) Tolerances which allow for use and wear throughout life.
  - 4) Adequate corrosion prevention/control features.
- c. Reduce maintenance downtime by designing for:
  - 1) Rapid and positive detection of malfunction or degradation.
  - 2) Rapid and complete preparation to begin maintenance.
  - 3) Rapid and positive localization of malfunctions to the repair level for which skills, spaces and test equipment are planned.
  - 4) Ease of fault correction.
  - 5) Rapid and positive adjustment and calibration.
  - 6) Rapid and positive verification of correction.
- d. Reduce design-dictated maintenance support costs by limiting:
  - 1) The need for specialized maintenance tools, support equipment and facilities.
  - 2) The requirement for depot or factory maintenance, consistent with system/cost effectiveness.
  - 3) The need for extensive maintenance technical data.
- e. Limit maintenance personnel requirements by applying human engineering principles such as:

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- 1) Identification and accessibility of parts, test points, adjustments and connections.
- 2) Easy handling, mobility, transportability and storeability.
- 3) Logically sequenced maintenance tasks.
- 4) A feasible range of relevant personnel physiological parameters.

f. Reduce the potential for maintenance error by designing to eliminate:

- 1) The possibility of incorrect connection/assembly/installation.
- 2) Dirty, awkward and tedious job elements.
- 3) Ambiguity in maintenance labeling, coding and technical data.

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| 13. ABSTRACT<br>This Engineering Test Procedure describes test data requirements and methods of data reduction used for evaluating the maintenance characteristics of an item being tested. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications. |  |  |

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|                             | ROLE   | WT | ROLE   | WT | ROLE   | WT |
| Engineering Test            |        |    |        |    |        |    |
| Maintainability Data        |        |    |        |    |        |    |
| Maintenance/Maintainability |        |    |        |    |        |    |
| Test Procedure              |        |    |        |    |        |    |

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